A *Genlisea* Myth is Confirmed

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The genus *Genlisea* comprises approximately 20 known species, divided more or less equally between Africa and the New World tropics and subtropics. The unique inverted "Y"-shaped corkscrew traps of *Genlisea* species as well as the five calyx lobes (versus two or rarely four) allow one to easily differentiate any species in this genus from species belonging to the closely related genus *Utricularia*, also a member of the Lentibulariaceae family.

All species of *Genlisea* produce basal rosettes of light to dark-green leaves, which are usually a few millimeters to a few centimeters in length, and which vary from spatulate to filiform in shape. The exceptions include *G. angolenensis* R.D. Good, *G. guianensis* N.E. Brown, and *G. sanariapoana* Steyermark which have elongated strap-shaped leaves. Furthermore, the leaves of the latter two species are often deep red in color and may reach 20 cm in length.

Genlisea aurea A. Saint-Hilaire has one of the most unique leaf rosettes in the genus, consisting of dozens, maybe hundreds, of narrow leaves covered in clear gelatinous mucilage. On the other hand *G. uncinata* Fromm-Trinta often has only 1-3 leaves per plant and most of the photosynthesis appears to be carried out by the long-lasting inflorescences.

The inflorescences of *Genlisea* vary widely in size, from hair-thin single-flowered scapes a few millimeters in height in *G. filiformis* A. Saint-Hilaire to thick succulent scapes over 1.2m in length in *G. uncinata*. Flowers vary in color between yellow, cream, white, lilac, purple, and pink, but do not vary too much in size (Fromm-Trinta 1979; Taylor 1991). The taxonomy of *Genlisea* is heavily based on inflorescence pubescence: presence or absence of hairs, whether these are glandular or simple, as well as their density and distribution.

The genus *Genlisea* is divided into two sections, *Genlisea* and *Tayloria*, based on the way their fruits open when mature. Section *Tayloria* represents only three species from Brazil (*G. uncinata*, *G. violacea* A. Saint-Hilaire, and *G. lobata* Fromm-Trinta), with fruits that dehisce into two longitudinal valves. Section *Genlisea* includes all other species in the genus with unique fruits that are circumscissile, splitting in a circumference halfway up from the base as well as along two circles (akin to latitude lines on a globe) further towards the apex (Taylor 1991).

Although only *G. repens* Benj. is reported to form elongated underground stolons—like many *Utricularia* species—most species of *Genlisea* do in fact form a very short but visible stem from which arise the basal rosette of photosynthetic leaves, traps, and inflorescences (Fromm-Trinta 1979; Fischer & Porembski 2000). When these structures are removed, the stem is usually beige in color and cylindrical to obconical. The largest I have seen were on *G. aurea*, with stems up to approximately 1.5cm in length by 4mm in diameter.

Both annual and perennial species are known in the genus *Genlisea*. Annual species often occur in seasonally moist sandy soils (e.g. *G. filiformis*) and in thin layers of soil or mosses over rocks on mountainsides (e.g. *G. lobata* and *G. stapfii* A. Chev.). Perennial species often occupy permanently boggy areas (e.g. *G. hispidula* Stapf, *G. margaretae* Hutchinson, and *G. aurea*) and sometimes even semi-aquatic habitats on floating mats of dead vegetation at the edges of streams, ponds or lakes (e.g. *G. guianensis*, *G. glandulosissima* R.E. Fries, and *G. repens*) (Fischer & Porembski 2000; Fromm-Trinta 1979).

A few species of *Genlisea* (e.g. *G. pygmaea* A. Saint-Hilaire, *G. roraimensis* N.E. Brown, and *G. violacea*) do not clearly fit either category, possibly being best described as facultative (optional) annuals. These species are usually found in sandy soils that may be very wet during the rainy season, but which become barely moist to bone-dry during the dry season.

Genlisea pygmaea is a widespread and very polymorphic species. In a previous publication (Rivadavia 2000) I discussed a large form of this taxon—the only one known to me at the time.

Figure 1: A close view of the tuber attachment in *G. pygmaea*.

Figure 2: Numerous *G. pygmaea* tubers in the author's hand. A cm scale bar is shown for reference.

Since then, I have seen numerous smaller growth types in Brazil (from Minas Gerais state in the southeast to Pará state in the north to Mato Grosso state in the west) and southeastern Venezuela (Gran Sabana, Bolívar state). This species has also been reported for Colombia, Guyana, and Trinidad (Taylor 1991).

Recently, *G. pygmaea* was reported to produce two kinds of traps; short traps that spread horizontally from the stem and elongated traps that extend vertically into the soil (Studni?ka 1986). Because *Genlisea* traps are so fragile and often break when collected, dimorphic traps are probably common among other species in the genus and have simply been overlooked. I have personally seen such dimorphism in three other species: *G. aurea*, *G. glandulosissima*, and *G. uncinata*.

I have observed *G. pygmaea* growing in habitats varying from steamy coastal plains near the equator all the way up to cool highlands at 1500m altitude. Smaller forms of *G. pygmaea* grow apparently as annuals in habitats that become heavily desiccated during the dry season. Yet larger forms of this species have always been somewhat of an ecological puzzle to me. Although their habitats also seem to dry out completely, I have found robust *G. pygmaea* specimens in flower very early in the wet season. This suggested to me that they were perennials and that somehow they were able to survive the dry season, maybe by growing in slightly wetter habitats.

I finally solved this puzzle in June 2007, during a trip to the Chapada dos Veadeiros highlands in northeastern Goiás state, in central Brazil. The dry season was picking up momentum and had already taken its toll. Only a few rare patches of the common annuals *G. filiformis*, *Drosera sessilifolia* A. Saint-Hilaire, *Utricularia laciniata* A. Saint-Hilaire & Gir., and *U. amethystina* Salzm. ex A. Saint-Hilaire & Gir. were still visible. Winter dormant *Drosera* species, such as *D. montana* A. Saint-Hilaire var. *montana* and *D. hirtella* A. Saint-Hilaire var. *hirtella* were already shutting down, while *D. cayennensis* Sagot ex Diels had already retreated completely underground and left no traces on the soil surface.

At 1470m altitude, in a sandy habitat among sparse grasses, where numerous other carnivorous plant species grew sympatrically or in neighboring habitats, I found a population of *G. pygmaea* which also seemed to be shutting down with the oncoming dry season. The leaf rosettes did not look very healthy and only flowerless inflorescences with fruit remained (the characteristic pubescence of the flower scape identified this species). The *G. pygmaea* common on the Chapada dos Veadeiros is probably the largest form of this species—also found on the Espinhaço Highlands of Minas Gerais in areas surrounding the city of Diamantina and on the Serra do Cipó.

In order to make herbarium specimens of *G. pygmaea* from this habitat and record its presence there, I began digging up a few plants. As I shook and scraped the sandy soil from around and beneath the rosettes, also removing grasses and other plants, I saw a few small white tubers (see Back Cover). At first I thought they belonged to one of the other plant species. But by the third or fourth scoop of soil, I knew it was too much of a coincidence that those tubers were always located directly beneath the *G. pygmaea* rosettes!

Although I was already certain of what I had found, I bagged a few scoops of soil with *G. pygmaea* and saved them. Two days later I was c.250km south of the Chapada dos Veadeiros, at a nice hotel in our capital, Brasília. There, I was able to sit calmly in the shower of a well-illuminated bathroom for a few hours, while I slowly and patiently cleaned *G. pygmaea* rosettes. It was extremely difficult to wash away the soil and remove bits and pieces of other plants without damaging *G. pygmaea* and breaking off the tubers. Out of about five to ten plants that were cleaned, I was only able to keep a tuber attached to the stem of a single specimen, although almost all the leaves and traps broke off.

This specimen allowed me to see how the short stem of *G. pygmaea* had suddenly made a "U" turn and grown downwards for about half a centimeter, where the tuber was formed (Figure 1). I was able to confirm this a week later while exploring near the town of Cristalina, about 150km south of Brasília. There, I found more *G. pygmaea*, this time growing in open sandy patches, without any other plants growing among them. I collected a few rosettes, and then washed them at night. Once again I was able to obtain a single clean specimen with the tuber still attached.

Although I saw up to three tubers underneath a few plants, it appears that each leaf rosette produces a single tuber. Multiple tubers probably were a result of multiple plants growing in close proximity. Each tuber measured 2-9mm in length and 2-8 in width (Figure 2). Bits of brown skin were present on the surface of some tubers, coming off very easily.

A few days after discovering the tubers I wrote to my good friend and carnivorous plant enthusiast, Marcos Cardoso, who lives Cuiabá, Mato Grosso state. A few months earlier we had visited together a population of a medium-sized form of *G. pygmaea* on the nearby Chapada dos Guimarães highlands. After seeing my pictures from the Chapada dos Veadeiros he was easily convinced to revisit this site, which he did a few days later. Although he dug up a several specimens, he saw no signs of tubers on the local *G. pygmaea*.

Thomas Carow from Germany (one of the greatest carnivorous plant cultivators and explorers) reported seeing tubers in *G. pygmaea* he collected in Brazil in the late 1980s around Diamantina, Minas Gerais (pers. comm.). I guess nobody really believed him and maybe he did not believe it himself. I know I could not believe my own eyes when I saw them! After all, no species of *Genlisea* was known to form tubers!

Tubers in *G. pygmaea* are certainly an adaptation to survive the dry season, which in Brazil south of the Amazon Basin occurs during winter, more or less from May to November. These structures were overlooked for so long because they are probably only produced early in the dry season and are attached to a live leaf rosette for a very short time, maybe 1-3 months. Thus, one would have to collect *G. pygmaea* rosettes at the right time of year in order to find the tubers attached. Several species of *Utricularia* (e.g., *U. brachiata* (R.Wight) Oliv., *U. campbelliana* Oliv., *U. geminiloba* Benj., *U. mannii* Oliv., and *U. menziesii* R.Br.) are also known to form tubers to help survive the dry season (Taylor 1989).

The confirmation that *G. pygmaea* produces tubers raises several interesting questions. The first of course is whether there are other species in the genus with this ability, but which have also been understudied and thus overlooked. A more specific question would be if all *G. pygmaea* populations produce tubers or not. And if there are truly annual forms of *G. pygmaea* that do not produce tubers, should these be separated from the perennials as a different species? And finally, such a case, should the name *G. pygmaea* be used for the tuberous or non-tuberous plants?

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